

CLAIMS

1. A method of soldering a lead-free solder which comprises:

melting the lead-free solder (101) which is an alloy of tin with no lead contained; and

acting ultrasonic vibration for increasing a joining strength between a mount article (1) and a member (5) to be mounted to at least one of the mount article and the member to be mounted which are to be joined by the lead-free solder, and the lead-free solder when solidifying the molten lead-free solder.

2. The method of soldering the lead-free solder according to claim 1, wherein the ultrasonic vibration is such that makes crystals of components contained in the lead-free solder fine and prevents segregation of the contained components, and increases the joining strength between the mount article and the member to be mounted.

3. The method of soldering the lead-free solder according to claim 1, wherein the ultrasonic vibration is such that makes crystals of components contained in the lead-free solder fine and prevents segregation of the contained components at a joining interface of at least one of the mount article and the member to be mounted, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

4. The method of soldering the lead-free solder according to claim 2, wherein the ultrasonic vibration is such that makes fine crystals of components contained in the lead-free solder and prevents segregation of the contained components at a joining interface of at least one of the mount article and the member to be mounted, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

5. The method of soldering the lead-free solder according to claim 2, wherein the contained components include a component of a melting point decrease action metal for acting to decrease a melting point of the lead-free solder.

6. The method of soldering the lead-free solder according to claim 3, wherein the contained components include a component of a melting point decrease action metal for acting to decrease a melting point of the lead-free solder.

7. The method of soldering the lead-free solder according to claim 4, wherein the contained components include a component of a melting point decrease action metal for acting to decrease a melting point of the lead-free solder.

8. The method of soldering the lead-free solder according to claim 3, wherein, when the mount article and

the member to be mounted contain Cu, the ultrasonic vibration is such that increases a thickness of a layer of a compound of Sn included in the lead-free solder and the Cu, the compound existing at the joining interface, and  
5 increases the joining strength between the mount article and the member to be mounted at the joining interface.

9. The method of soldering the lead-free solder according to claim 4, wherein, when the mount article and the member to be mounted contain Cu, the ultrasonic  
10 vibration is such that increases a thickness of a layer of a compound of Sn included in the lead-free solder and the Cu, the compound existing at the joining interface, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

15 10. The method of soldering the lead-free solder according to claim 5, wherein, when the mount article and the member to be mounted contain Cu, the ultrasonic vibration is such that increases a thickness of a layer of a compound of Sn included in the lead-free solder and the  
20 Cu, the compound existing at the joining interface, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

11. The method of soldering the lead-free solder according to claim 6, wherein, when the mount article and  
25 the member to be mounted contain Cu, the ultrasonic

vibration is such that increases a thickness of a layer of a compound of Sn included in the lead-free solder and the Cu, the compound existing at the joining interface, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

12. The method of soldering the lead-free solder according to claim 7, wherein, when the mount article and the member to be mounted contain Cu, the ultrasonic vibration is such that increases a thickness of a layer of a compound of Sn included in the lead-free solder and the Cu, the compound existing at the joining interface, and increases the joining strength between the mount article and the member to be mounted at the joining interface.

13. The method of soldering the lead-free solder according to claim 1, wherein the lead-free solder has a Sn-Ag based composition as a main ingredient.

14. The method of soldering the lead-free solder according to claim 12, wherein the lead-free solder has a Sn-Ag based composition as a main ingredient.

15. The method of soldering the lead-free solder according to claim 13, wherein the contained components include an alloy component of the Sn-Ag.

16. The method of soldering the lead-free solder according to claim 14, wherein the contained components include an alloy component of the Sn-Ag.

17. The method of soldering the lead-free solder according to claim 5, wherein the melting point decrease action metal is at least one of Bi, Cu, Zn and In.

5 18. The method of soldering the lead-free solder according to claim 8, wherein the melting point decrease action metal is at least one of Bi, Cu, Zn and In.

19. The method of soldering the lead-free solder according to claim 13, wherein the melting point decrease action metal is at least one of Bi, Cu, Zn and In.

10 20. A Joined object soldered with the use of the method of soldering the lead-free solder according to any one of claims 1-19.